

AD-A271 276



2

THEORETICAL AND EXPERIMENTAL RESEARCH ON COHERENT MICROWAVE BACKSCATTER FROM THE OCEAN

Dr. Robert E. McIntosh

omnet: R.MCINTOSH

Department of Electrical and Computer Engineering

Knowles Engineering Building

University of Massachusetts

Amherst, MA 01003



FINAL REPORT

CONTRACT NUMBER: N00014-88-K-0443

Goals

The development of frequency and polarization diverse radars to measure coherent backscatter of microwave signals from the ocean surface to better understand the effects of surface motion on synthetic aperture radar (SAR) images.

Objective

This document has been approved
for public release and sale; its
distribution is unlimited.

This one-year effort had following objectives:

1. To design, develop and test radar systems that will be used during the second phase of the SAXON experiment - SAXON-FPN. Two radar system were prepared for the SAXON-FPN: (1) a dual frequency and dual polarization radar - PolScat and (2) a

DEFENSE TECHNICAL INFORMATION CENTER



9325373

6pgs

93 10 20 1 18 1

**Best
Available
Copy**

Ka-band Scatterometer.

2. To support the analysis of the data collected by the Stepped Frequency Delta-K (SFDK) radar during the SAXON-CLT experiment. Results of this analysis were reported in the publications listed at the end of this report.
3. To support preliminary studies of simulated ocean SAR images that lead to the development of the ONR sponsored Focused Phased Array Imaging Radar (FOPAIR).

Approach

We have fabricated two radars for SAXON research: The first sensor, termed PolScat, operates at both C-band and X-band, and the second is a Ka-band Scatterometer. Both instruments obtain radar returns for all combinations of linear polarizations. PolScat can measure the radar reflectivity of the ocean surface for co- and cross-pol within 40 μs at two frequencies by using a specially designed switching matrix. The Ka-band Scatterometer must be mechanically re-configured for different polarization settings (e.g. VV, HH or HV). The Ka-Band Scatterometer uses an FM technique of stepping its carrier frequency over 300 MHz of bandwidth, thus achieving an instantaneous measurement of the range to the ocean surface with a resolution of 0.5 m. This provides information about the long wave spectrum of the ocean surface simultaneously with the backscatter measurements from both radars. Both radars are capable of high speed sampling of the returned signal, PolScat at 50 μs and the Ka-band radar at 10 ms, so that the effects of surface motion may be oversampled. The radars are configured so that they simultaneously observed the same footprint. This allows us to produce data covering a wide frequency range at all polarization combinations with common ocean surface parameters and ground truth measurements. The system configuration of PolScat is shown in Figure 1 and the Ka-band Scatterometer in Figure 2.

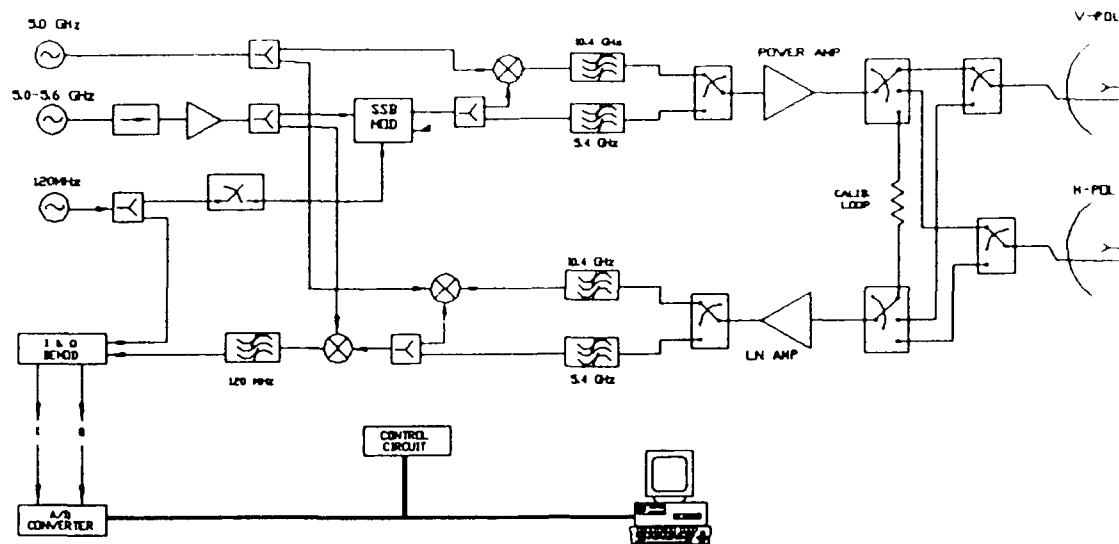


Figure 1: PolScat System Configuration

Research results obtained during the ONR-sponsored CLT experiment with the Stepped-Frequency ΔK (SFDK) radar system were also reported during this research effort. This frequency-agile C-Band system is capable of measuring ocean surface currents over long periods of time by use of the dual-frequency ΔK technique. This feature is useful for studying the dependence of ocean surface currents on wind conditions and sea state because: (1) the ΔK peak of the cross product spectrum can be constantly monitored to insure that the ocean wave conditions sustain the ΔK resonant peak from which current measurements are obtained and (2) the ability to monitor the Doppler frequency shift of the ΔK peak for long periods of time allows the response of ocean surface currents to gradual changes of the air-sea interface to be observed.

Tasks Completed

The SFDK radar and Ka-band Scatterometer took a part in a two-month, ONR sponsored, SAXON-CLT experiment during the fall of 1988. Extensive analysis of the Delta-K

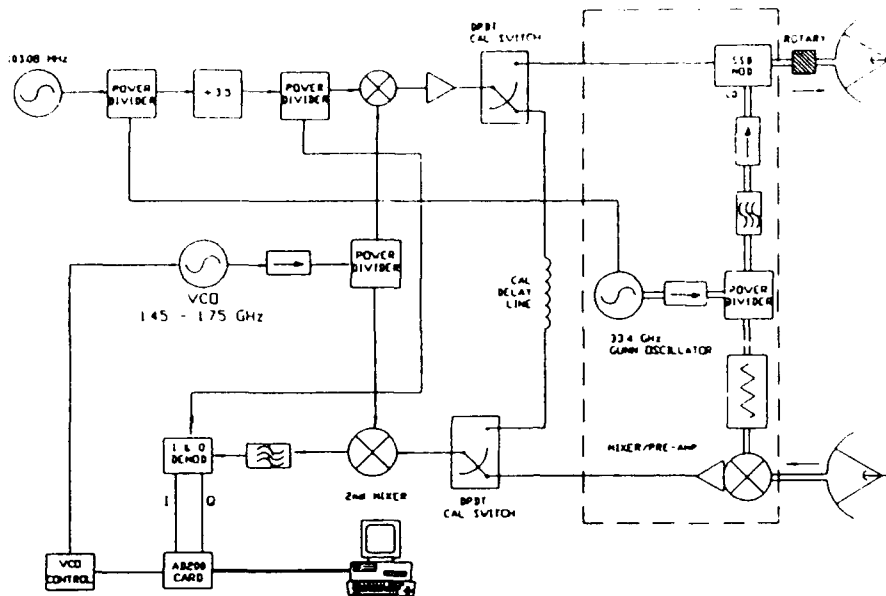


Figure 2: Ka-band Scatterometer System Configuration

data gathered the longest continuous records of ocean surface currents velocities available. These measurements allowed the first look at the effects of surface winds on the ocean currents.

The Ka-band Scatterometer was refabricated and successfully tested in June, 1990 at the U.S. Army's Coastal Engineering Research Center's Field Research Facility in Duck, N.C.. Improvements were achieved both in the sensitivity and the measurement stability of this instrument. Also, the data acquisition system was redesigned to allow faster sampling (100 Hz) so that this sensor could be used for decorrelation studies of radar return signal at Ka-band. These upgrades provided increased data quality during the SAXON-FPN experiment.

During the first half of 1990, PolScat was fully assembled, and preliminary field tests were performed. In August 1990, both sensors participated in the "dry-run" test for the SAXON-FPN experiment which was organized by the University of Massachusetts on the Amherst campus.

Publications from ONR sponsored work - FY 88/FY 93

PI: Robert E. McIntosh

Reviewed publications :

- 90-P** , Swift, C. T., "Passive Microwave Remote Sensing of Ocean Surface Wind Speed", Chapter 10 in "Surface Waves and Fluxes", Volume II - "Remote Sensing", G. L. Geerneart and W. J. Plant editors, Kulwer Academic Publishers, 1990
- 92-P** , Popstefanija, I. and R.E. McIntosh, "Measurements of the Effects of Surface Winds on Ocean Currents With a Stepped-Frequency ΔK Radar System", JGR-Ocean, Vol 97, No.C4, Pages 5597-5605, April 15, 1992
- 93-P** , Popstefanija, I., D.S. McQueen and R.E. McIntosh, "A Stepped-Frequency Delta-K Microwave Radar for Oceanographic Studies", IEEE Trans. On GRS, Vol. 31, No.3, May 1993

Conferences :

- 89-C** , Popstefanija, I. and McIntosh R. E., "Microwave Measurements of Ocean Surface Currents for the SAXON Experiment", IGARSS '89, 1512, Vancouver, Canada
- 89-C** , Popstefanija, I., et. al., "Simultaneous Ka-band scattering measurements and stereophotography", IGARSS '89, 1516, Vancouver, Canada
- 90-C** , Popstefanija, I., McIntosh R.E., "Ka-band Backscattering Measurements of Ocean Surface During SAXON Experiment", Ocean Sciences Meeting, AGU, New Orleans

90-C , Popstefanija, I., McIntosh R.E., "Measurements of Ocean Surface Currents with Multifrequency Radars", Marine Science Technology Meeting, Washington DC.

91-C , Popstefanija, I., McIntosh R.E., "A Study of Signal-to-Clutter ratio for a Multifrequency Delta-K radar", IGARSS '91, 1625, Espoo, Finland

Accession For	
NTIS	NTIS
DTIC	DTIC
AD	AD
DA	DA
By	
Distribution	
For Study Section	
Dist	Avail. and/or Special
A-1	